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WARM EPOCHS AND GLACIAL EPOCHS.*

THE present epoch which has already endured a vast number of centuries was preceded by a glacial epoch whose length was also very great but this glacial epoch itself was preceded by a warm period, this last by another cold period, etc., etc. It has been proved that cold periods have continuously alternated with warm ones in the past.

Investigations in the cave of the Cliffs of Grimaldi made under the direction of the Prince of Monaco by the Canon of Villeneuve, M. Lorenzi, have brought to light the skeletons of men and animals, rudimentary instruments and other objects, dating from the warm period which preceded the glacial era. This warm epoch was characterized by animals that were not clothed in furs, as were later the mammoths and the woolly rhinoceros. Europe was inhabited at this time by the primitive elephant, hippopotamus, rhinoceros without the dermal folds, etc.

The human skeleton found in the Grotto of Grimaldi belongs to an inferior race. The dentition of these skeletons is almost identical with that of the native Australians of our day.

We must not conclude from the discoveries that mankind in this distant epoch was represented only by the race to which these skeletons belong. We know that the most diverse races may have lived at that time just as is the case in our own day. The important fact of this discovery is not in the anatomy of the skeleton, but in the fact of their presence in the midst of the relics of animals which characterize an epoch preceding the glacial era.

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* Translated from the French manuscript by Lydia Gillingham Robinson.

We have known of the existence of this pre-glacial man by his instruments of silica which have been found in abundance, but this is the first time that the discovery of the man himself has been pointed out. It has thus been demonstrated that man has lived at least during two great periods, glacial and estival, which have preceded our present era. It is probable that traces of his presence will be found in epochs still more remote, but the recent discoveries bring under discussion the glacial and estival periods whose existance and long duration are unanimously recognized to-day.

The cosmical causes of these great alternating periods are of interest in that since they give the explanation of past phenomena they will permit us to pursue further phenomena, and we may prophesy that these periods will be reproduced in the future just as they have been produced in the past. These great alternating periods are occasioned by a rotary movement of the earth about itself with reference to latitude. This extremely slow rotation produces an adjustment (with relation to the perpendicular to the orbit) of the poles around which the daily rotation of the earth takes place.

This constitutes the third rotation of the earth around its own center of gravity. We know that the first rotation (diurnial) produces the alternations of day and night, the second rotation (annual) produces the seasons of each year, the third rotation which is slowest of all is also the most important.

It produces seasons which extend through thousands of centuries and whose intensity is in no sense comparable to that with which we are familiar. Its movement takes place at the rate of 46″ a century; a complete rotation is accomplished in 2,800,000 years in which interval two great glacial periods alternate with two great estival periods. This measurement of time permits us to determine the precise duration of glacial periods which heretofore has been made the subject of much controversy. If we assume an intermediate season of equal length between the great cosmical seasons, as is the case with our annual seasons, we see that each of these periods has a duration of 350,000 years, and that the making of each of these must be felt on the surface of the earth during 200,000 years at least. The slow roation of the earth with reference to latitude is known under the name of "diminution of the obliquity of the ecliptic." It has been thought that this movement is vibratory, but astronomical discoveries have shown that it is continuous and that the earth turning around its three axes following geometrical laws may be represented by a body freely movable in space.

This rotation explains all the geological phenomena which until now have remained shrouded in mystery. It also explains the great migrations of mankind, the commingling of races, etc. It throws a bright light upon the history of our planet, and permits us to determine numerically the different periods which have affected its surface.

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